

# EMC CCB review

## RUC upgrade – planned Sept08

### NOAA/ESRL/GSD/AMB

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NCEP/EMC – Geoff Manikin

Major transitions:

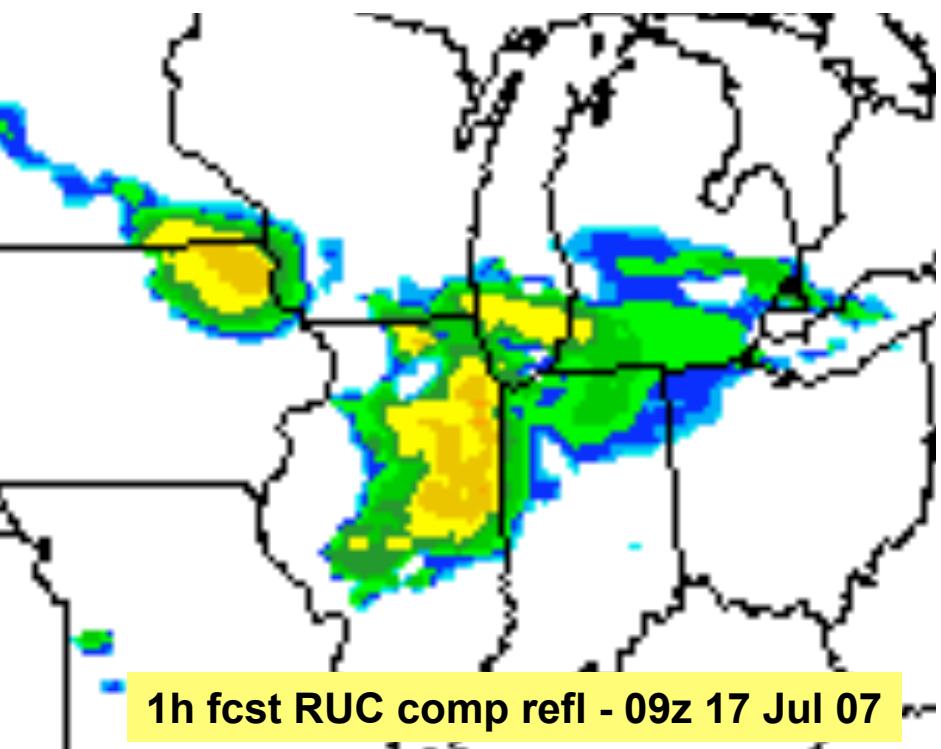
- RUC13 change package
  - radar reflectivity assimilation,
  - TAMDAR, mesonet,
  - model physics – radiation, convection,

29 July 2008



Earth System Research Laboratory  
SCIENCE, SERVICE & STEWARDSHIP

# RUC Upgrade at NCEP



RUC 13 change package

- Components
  - Assimilation of new obs - radar reflectivity, TAMDAR wind /temp/RH, mesonet winds
  - Improved surface, precip, reflectivity forecasts
- Status
  - in real-time parallel testing at NCEP (since Aug 2007)
  - Retrospective tests not easy with addition of radar reflectivity data

NCEP RUC parallel web site:

<http://www.emc.ncep.noaa.gov/mmb/ruc2/para>

Comparisons between para and oper RUC

# Changes for oper RUC upgrade

- Assimilation
  - Use of **radar reflectivity** in diabatic DFI in RUC model  
(also, hydrometeor assimilation component)
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  - **TAMDAR aircraft** observations  
(TAMDAR impact parallel RUC tests at GSD)
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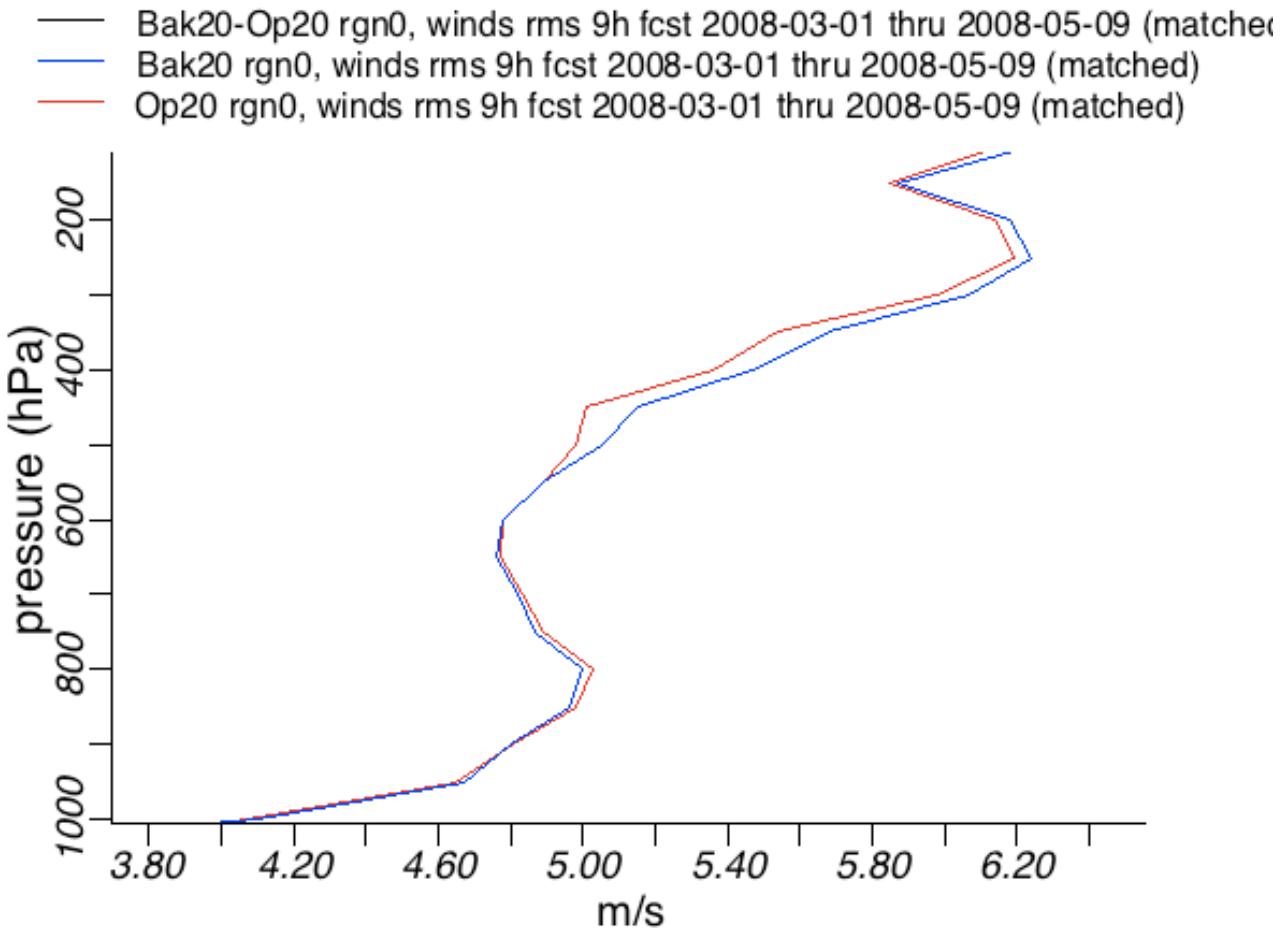
## **Scientific results**

- **ESRL/GSD – ongoing RUC parallel cycle with full radar reflectivity since March 2007**
- **EMC – ongoing parallel cycle since Aug 2007. Radar reflectivity availability became more reliable in Feb 2008**

### **Following multi-month comparisons**

- **Bak20**
  - parallel RUC at GSD using same code in parallel RUC testing at EMC
  - 13km RUC output interpolated to 20km
- **Ops 20**
  - operational RUC
  - 13km RUC output interpolated to 20km
-

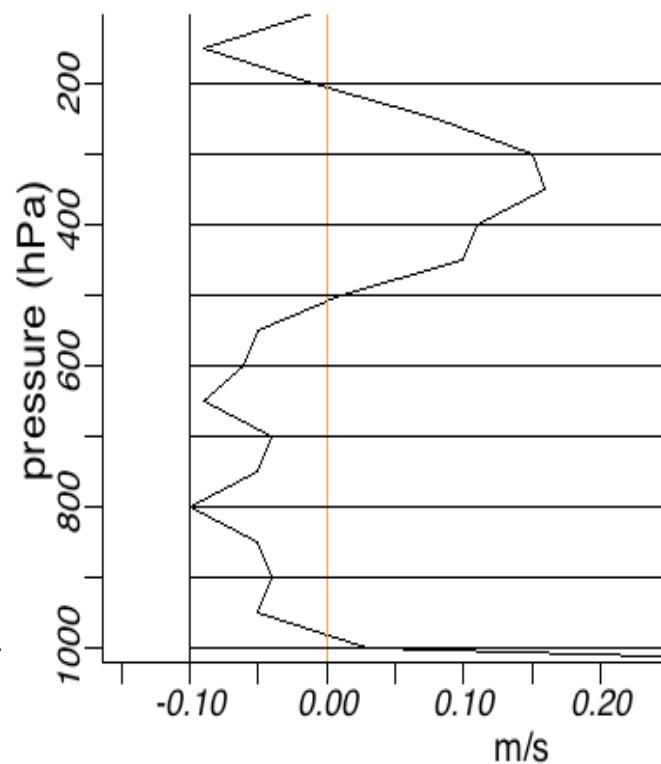
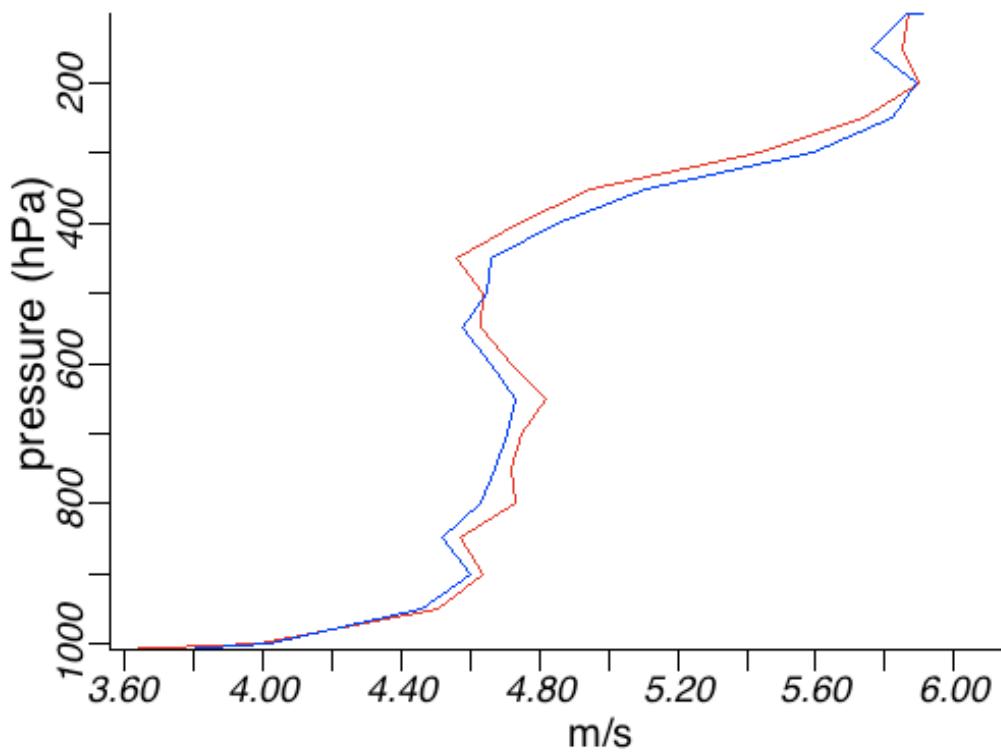
# Parallel test results



- **9h wind forecast**
- **Bak20 – parallel RUC at GSD using same code in testing at EMC**

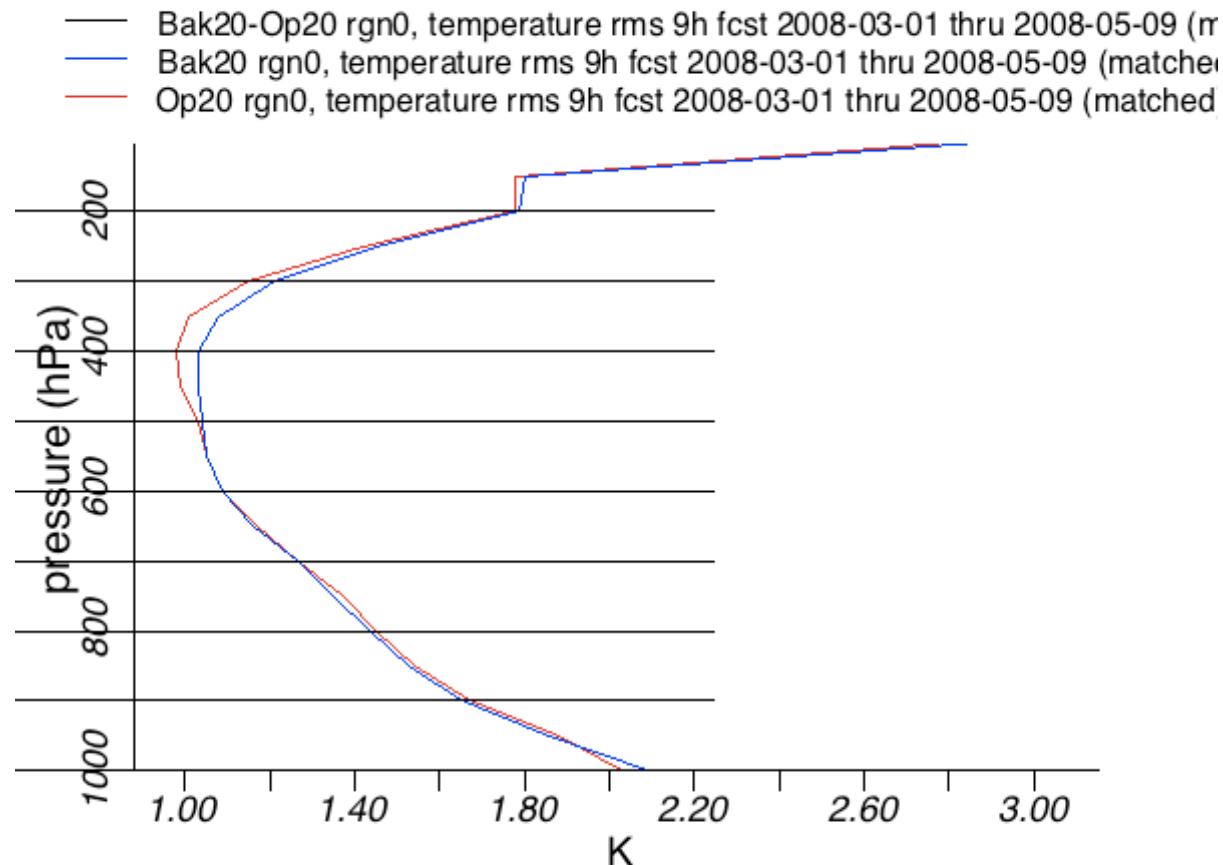
# Parallel test results – 15 June – 15 July 2008

— Bak20 rgn:RUC, winds rms 9h fcst 2008-06-15 thru 2008-07-1  
— Op20 rgn:RUC, winds rms 9h fcst 2008-06-15 thru 2008-07-1



- 9h wind forecast
- Bak20 – parallel RUC at GSD using same code in testing at EMC

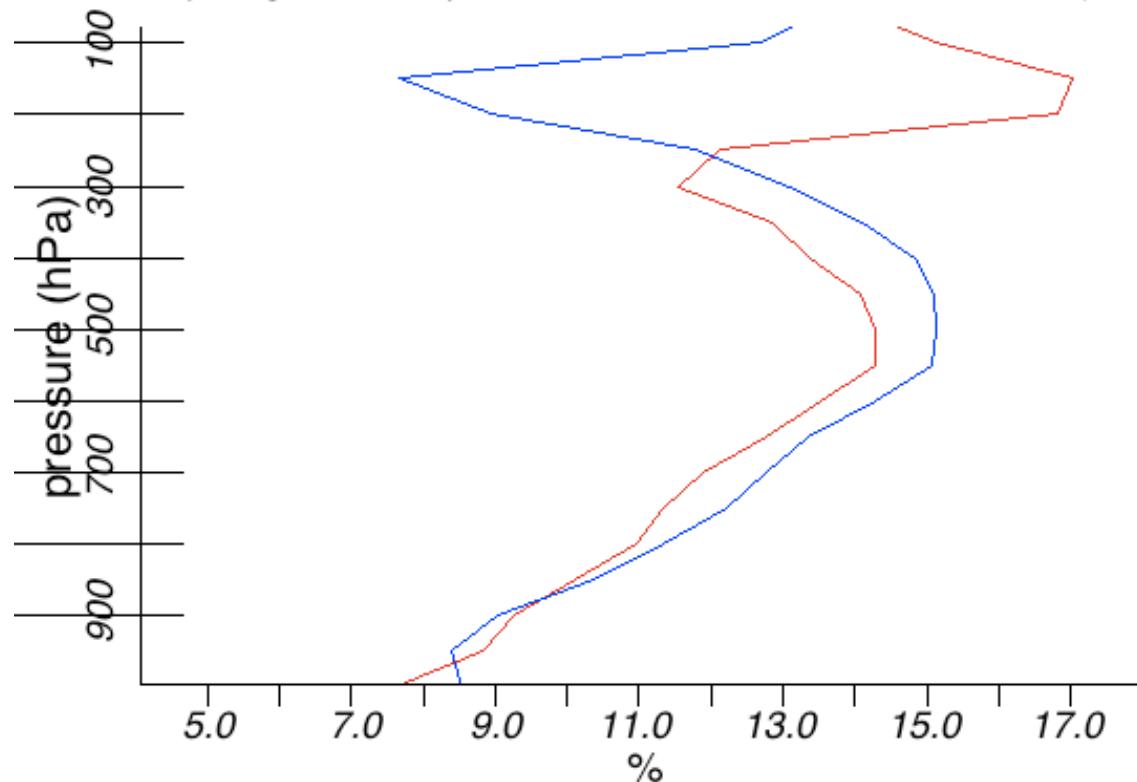
# Parallel test results – 9 h temperature



- 9h temp forecast
- Bak20 – parallel RUC at GSD using same code in testing at EMC

# Parallel test results – 0 h RH

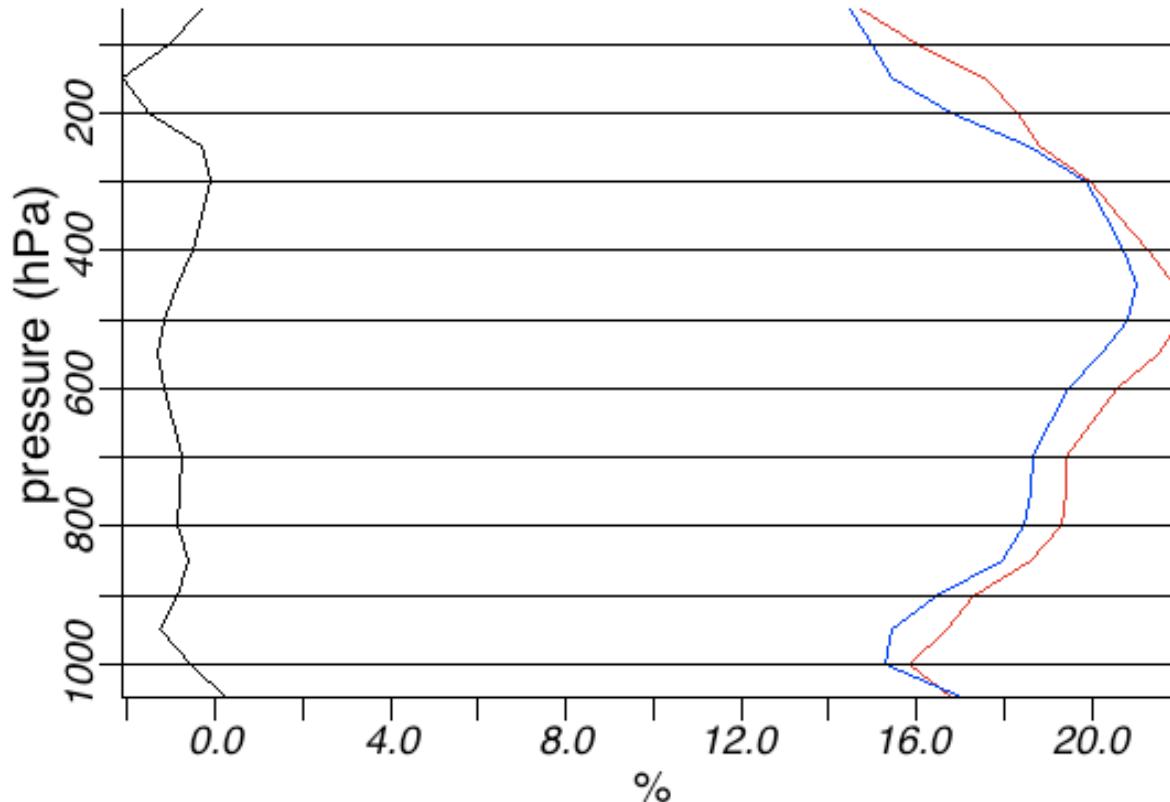
- Bak20-Op20 rgn0, humidity rms 0h fcst 2008-03-01 thru 2008-05-09 (matched)
- Bak20 rgn0, humidity rms 0h fcst 2008-03-01 thru 2008-05-09 (matched)
- Op20 rgn0, humidity rms 0h fcst 2008-03-01 thru 2008-05-09 (matched)



- 0h RH analysis
- Bak20 – parallel RUC at GSD using same code in testing at EMC

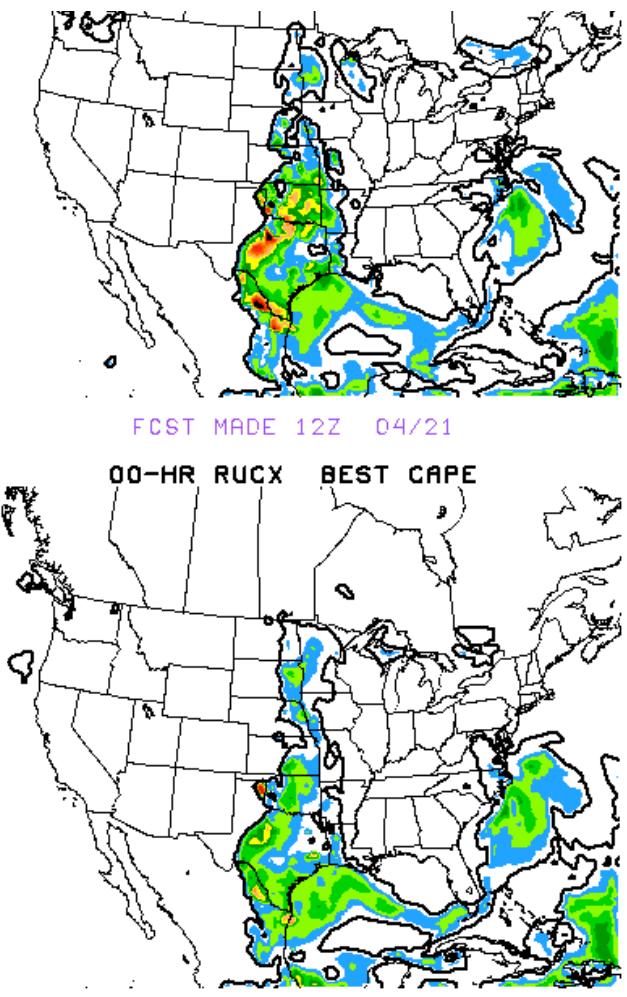
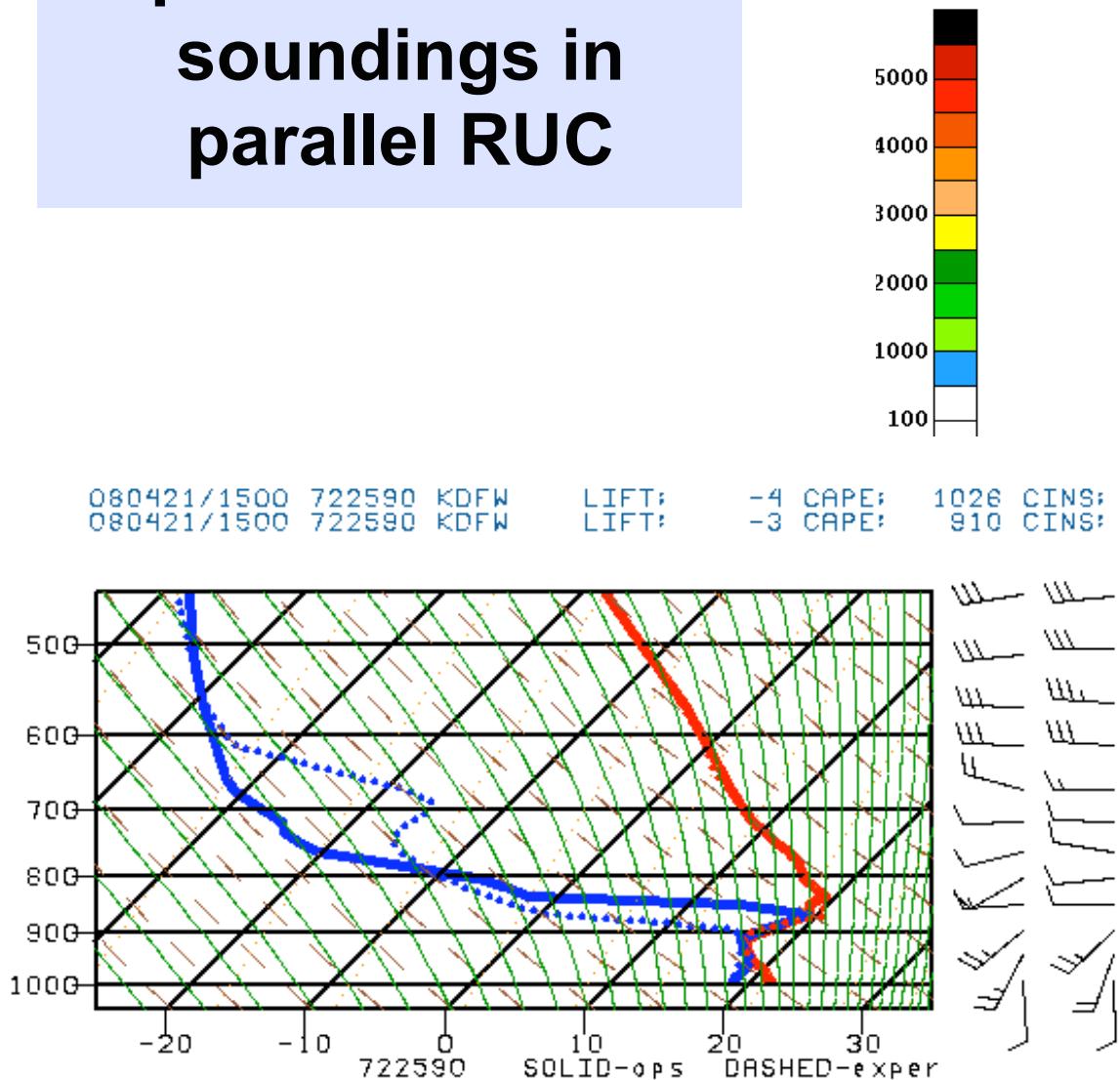
# Parallel test results – 9 h RH

- Bak20-Op20 rgn0, humidity rms 6h fcst 2008-01-09 thru 2008-05-09 (matched)
- Bak20 rgn0, humidity rms 6h fcst 2008-01-09 thru 2008-05-09 (matched)
- Op20 rgn0, humidity rms 6h fcst 2008-01-09 thru 2008-05-09 (matched)



- 9h RH forecast
- Bak20 – parallel RUC at GSD using same code in testing at EMC

# Improved moisture soundings in parallel RUC



# 2008 Changes for oper RUC upgrade

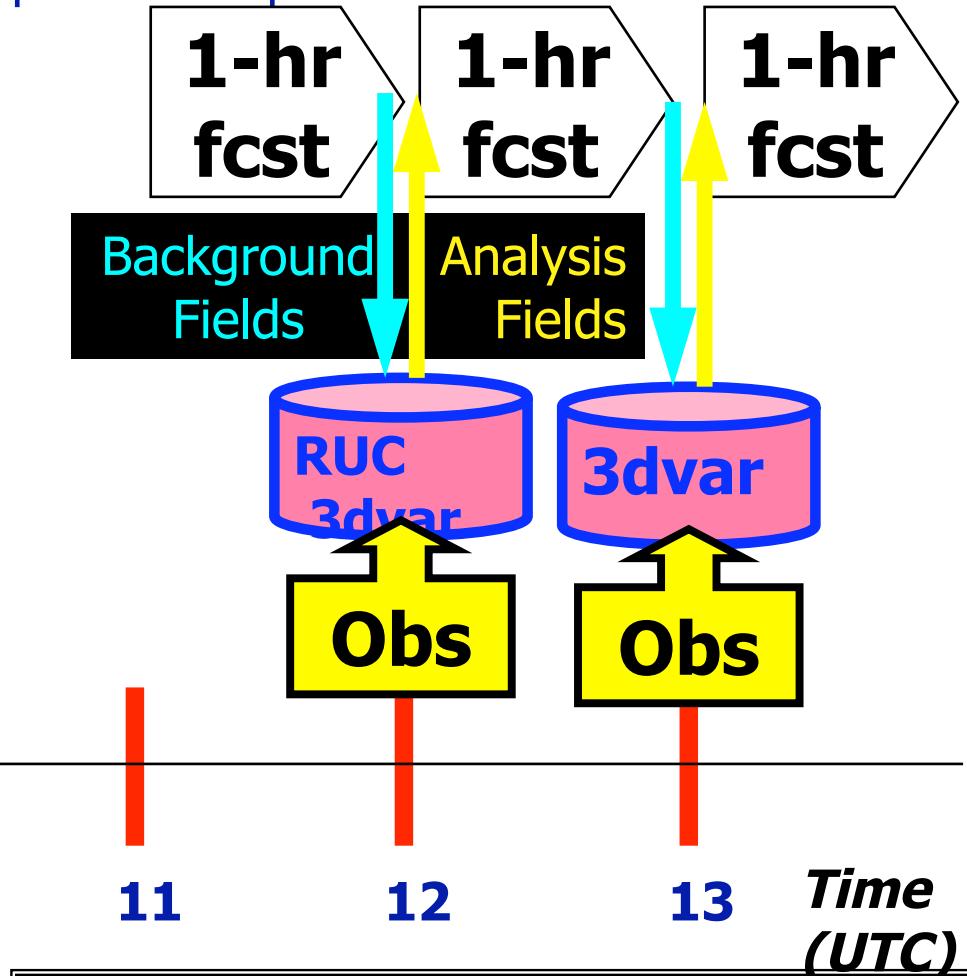
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RUC parallel web site:

<http://www.emc.ncep.noaa.gov/mmb/ruc2/para>

## New observations assimilated -- RUC upgrade

Cycle hydrometeor, soil temp/moisture/snow plus atmosphere state variables



### Hourly obs in 2008 RUC

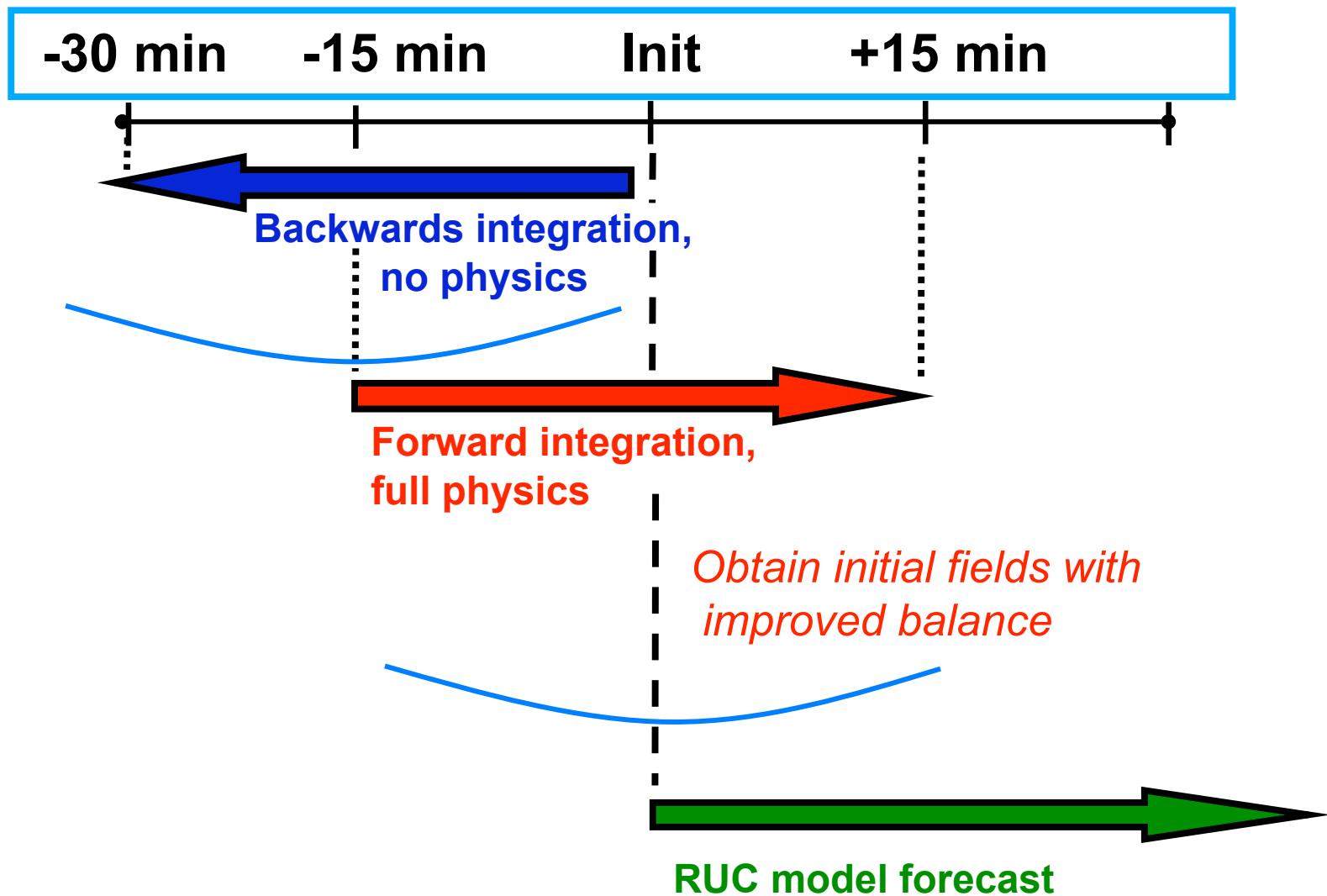
Data Type	~Number
Rawinsonde (12h)	80
NOAA profilers	30
VAD winds	110-130
PBL – prof/RASS	~25
Aircraft (V,temp)	1400-7000
<b>TAMDAR (V,T,RH)</b>	0 - 800
Surface/METAR	1800-2000
Buoy/ship	100- 200
GOES cloud winds	1000-2500
GOES cloud-top pres	10 km res
GPS precip water	~300
Mesonet (temp, dpt)	~7000
<b>Mesonet (wind)</b>	2000-4000
METAR-cloud-vis-wx	~1600
<b>Radar reflectivity</b>	2km

**RUC Hourly Assimilation Cycle**

# RUC Diabatic Digital Filter Initialization (DDFI)

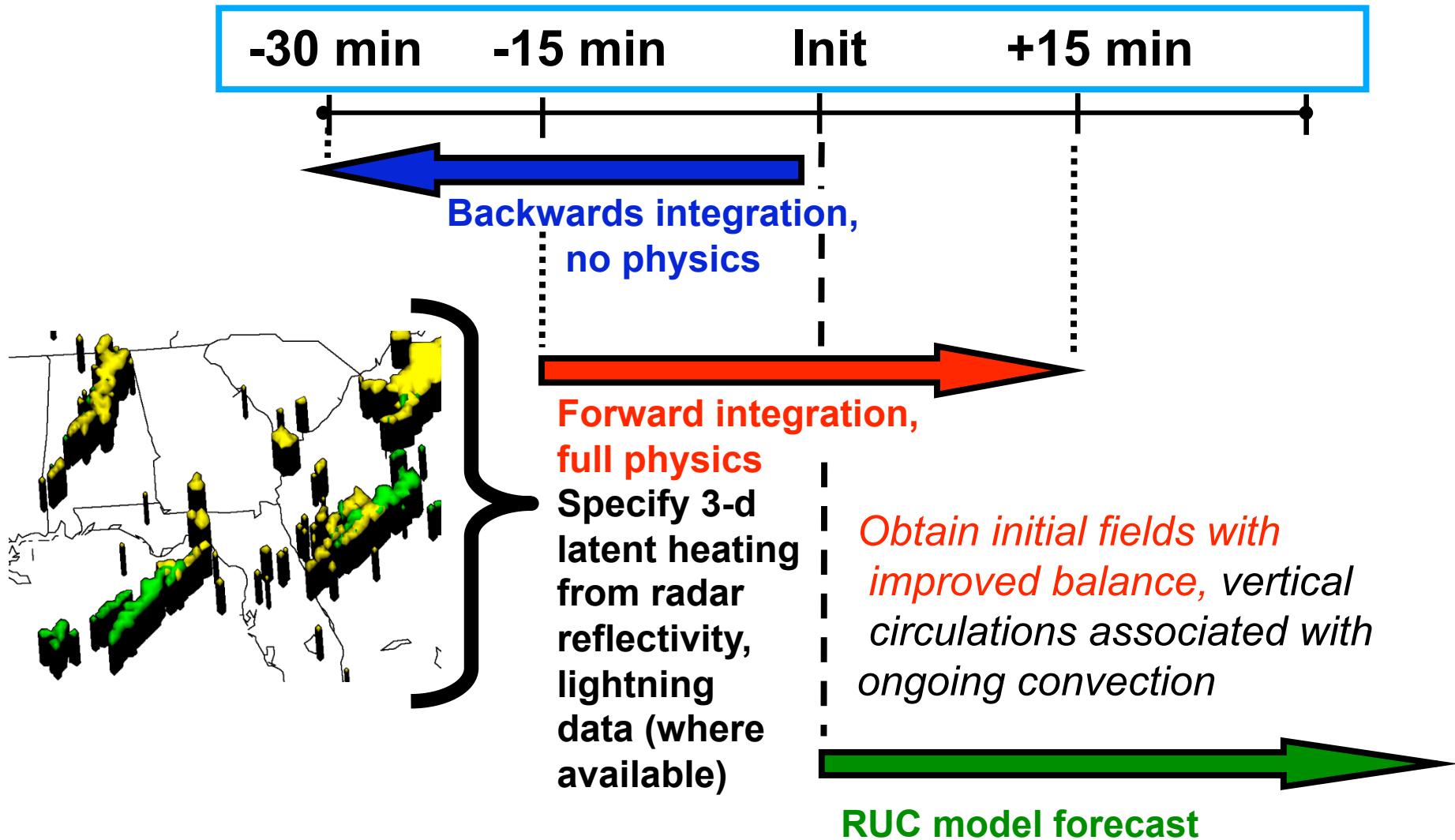
Initial DFI in RUC model at NCEP - 1998 - adiabatic DFI

Diabatic DFI introduced at NCEP - 2006



# Diabatic Digital Filter Initialization (DDFI)

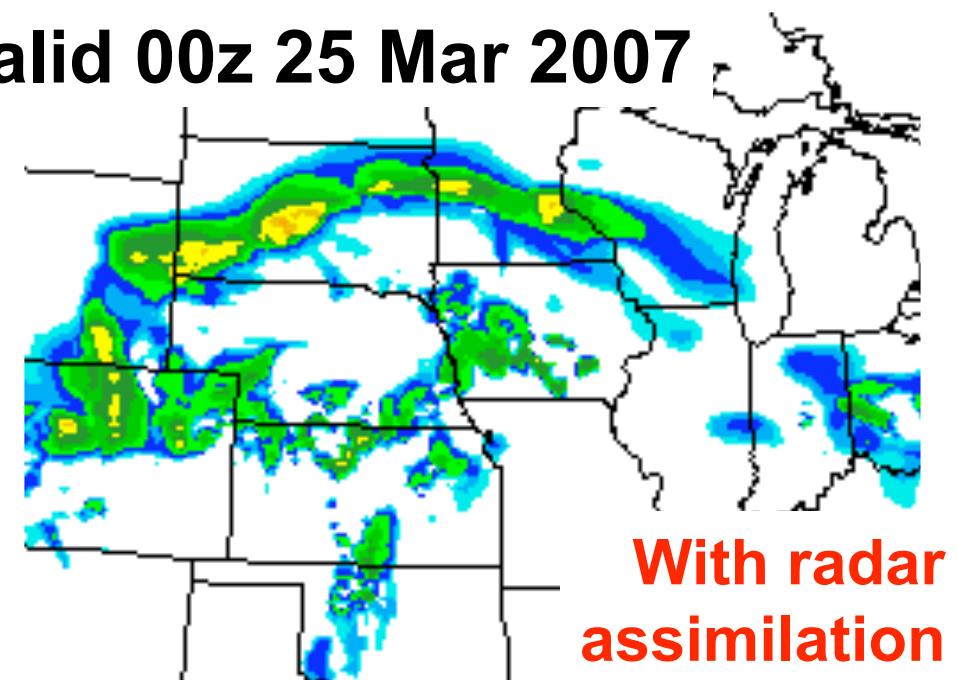
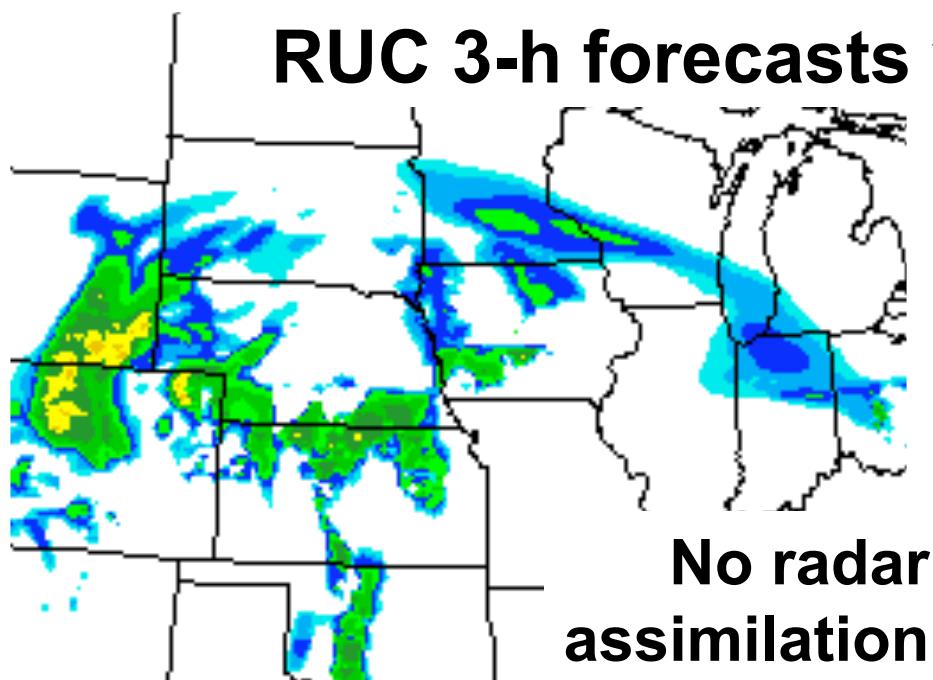
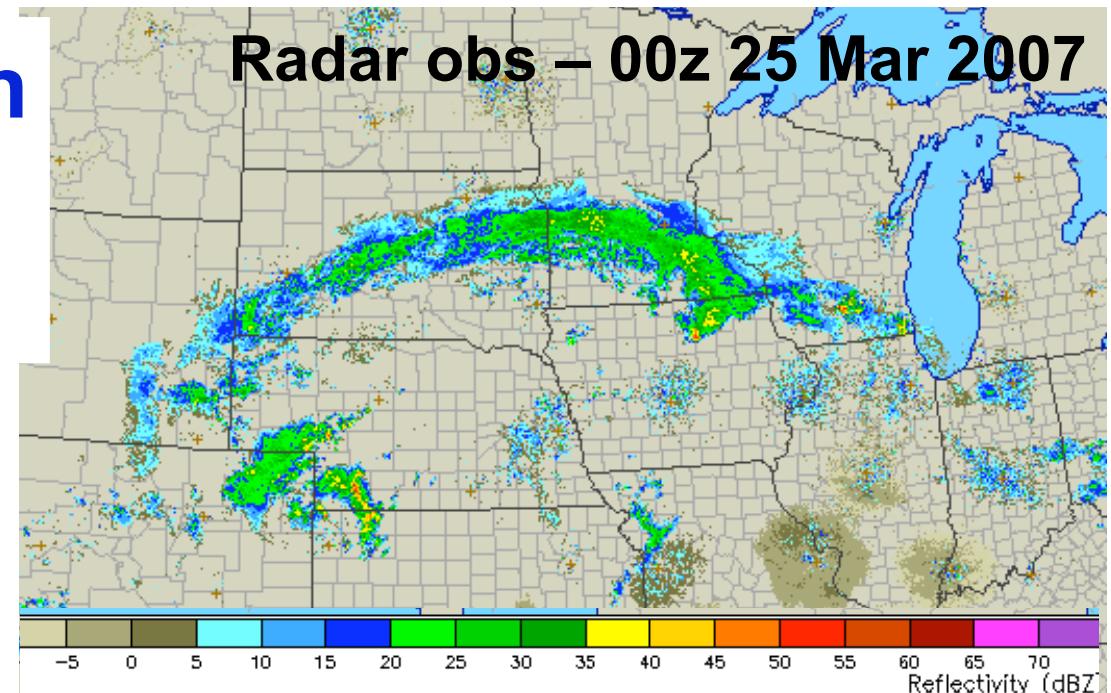
New - add assimilation of radar data



Radar reflectivity assimilation in RUC

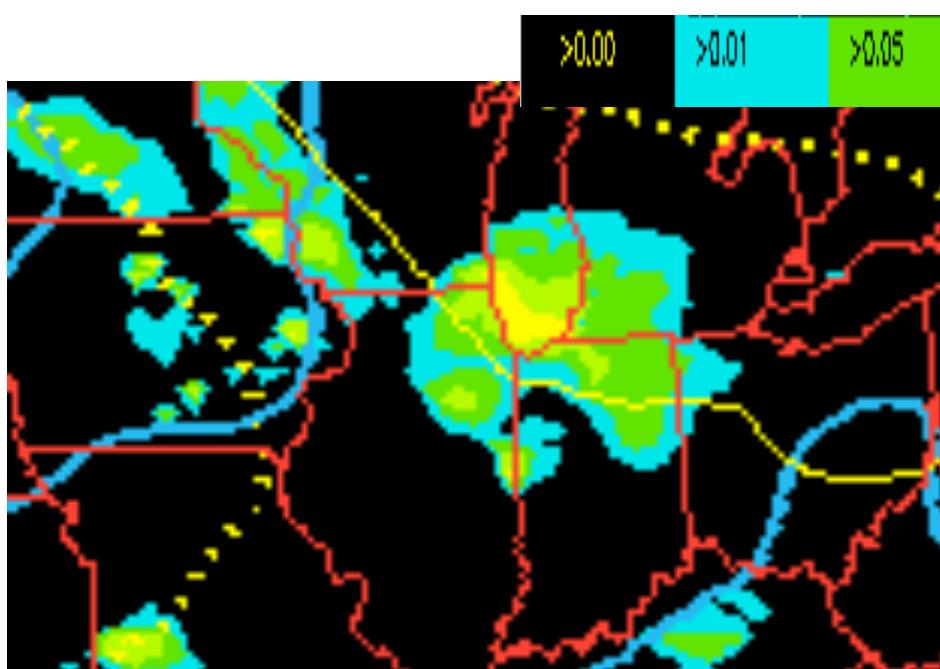
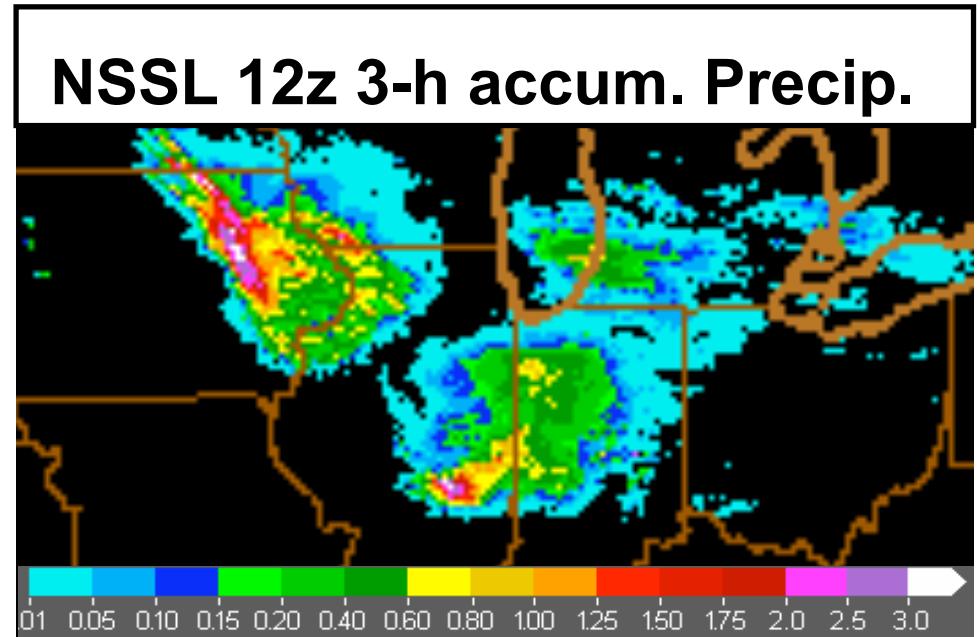
# Radar assimilation in RUC - winter storm example

Also, added simulated  
radar reflectivity field to  
RUC output

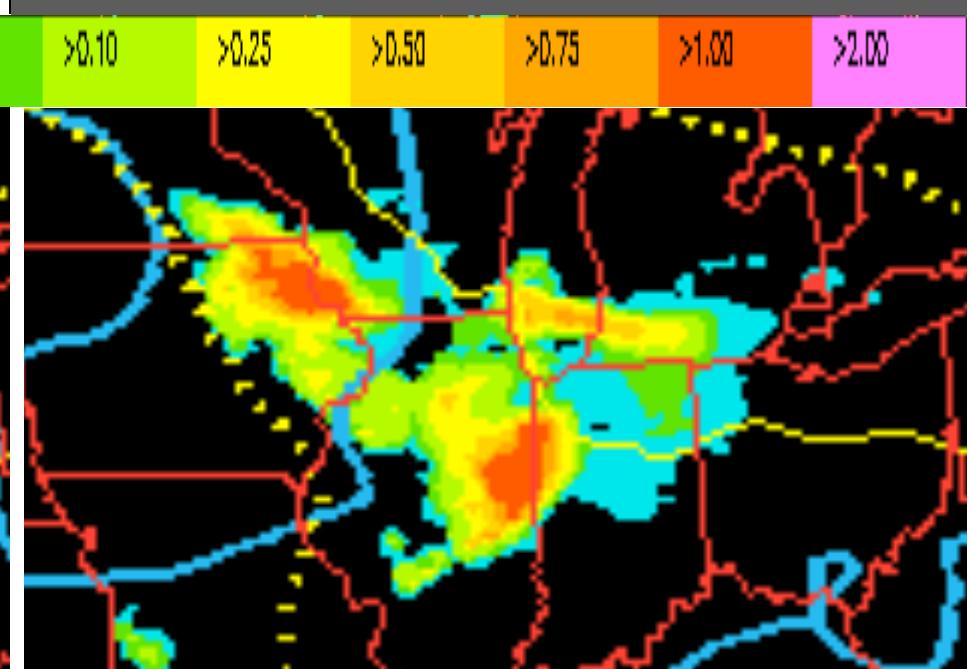


# Overall effect of RUC radar assimilation

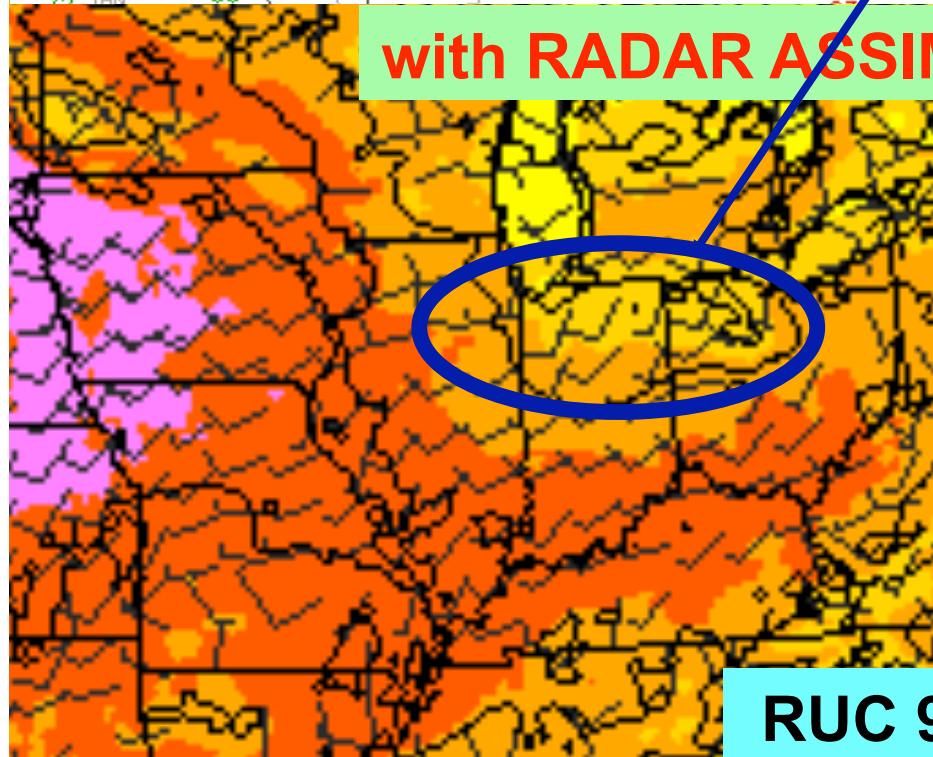
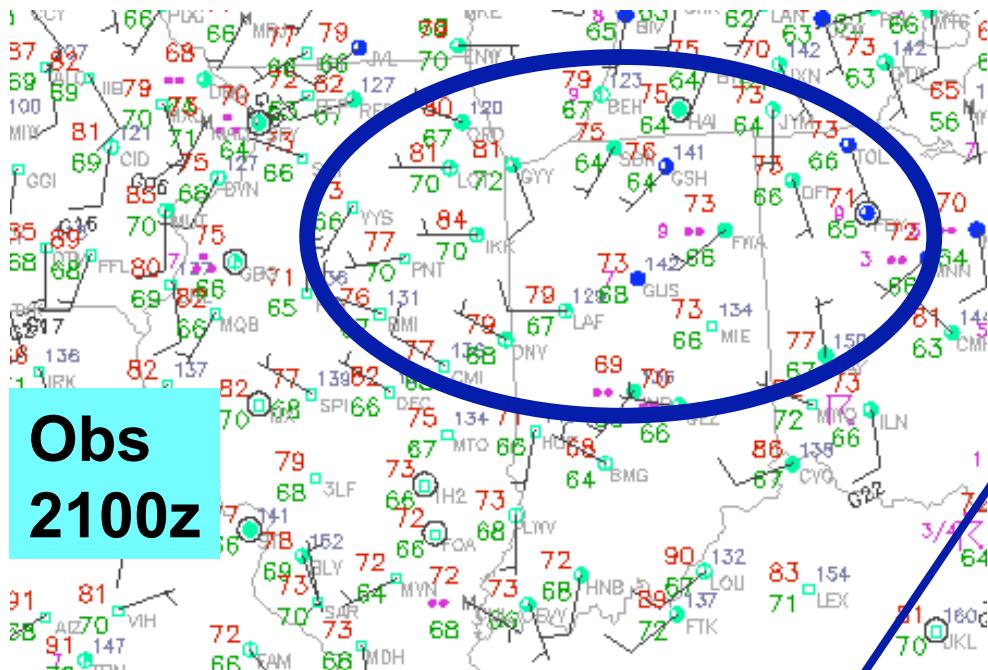
- Overnight convection example



No radar assimilation



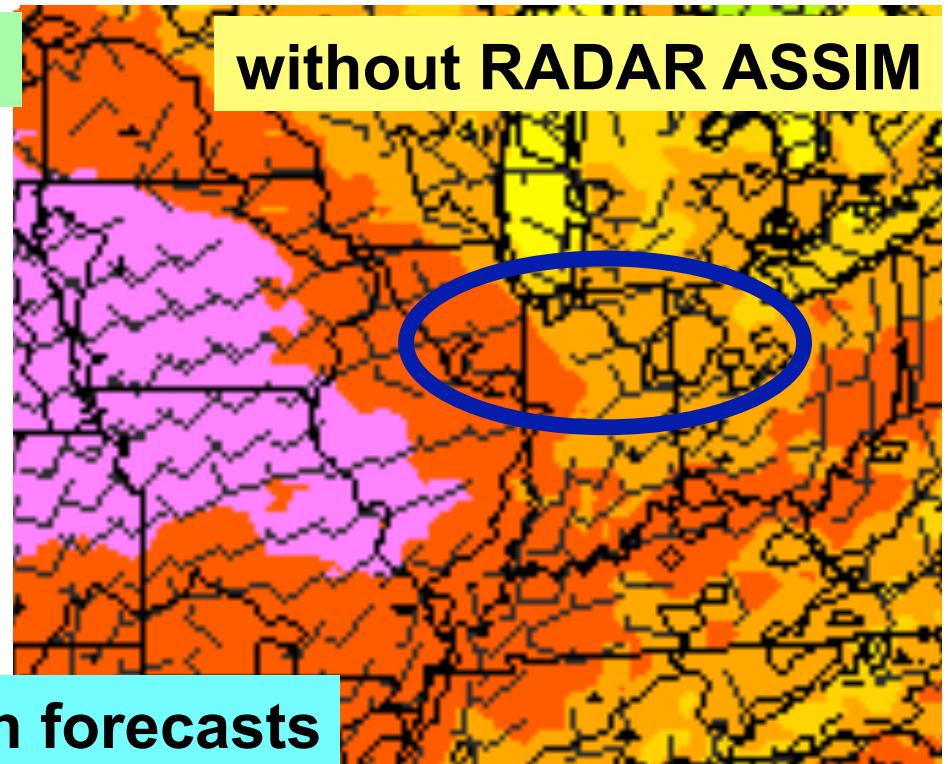
Radar assimilation



**Evaporative cooling  
- improved cold pool  
with radar assim**

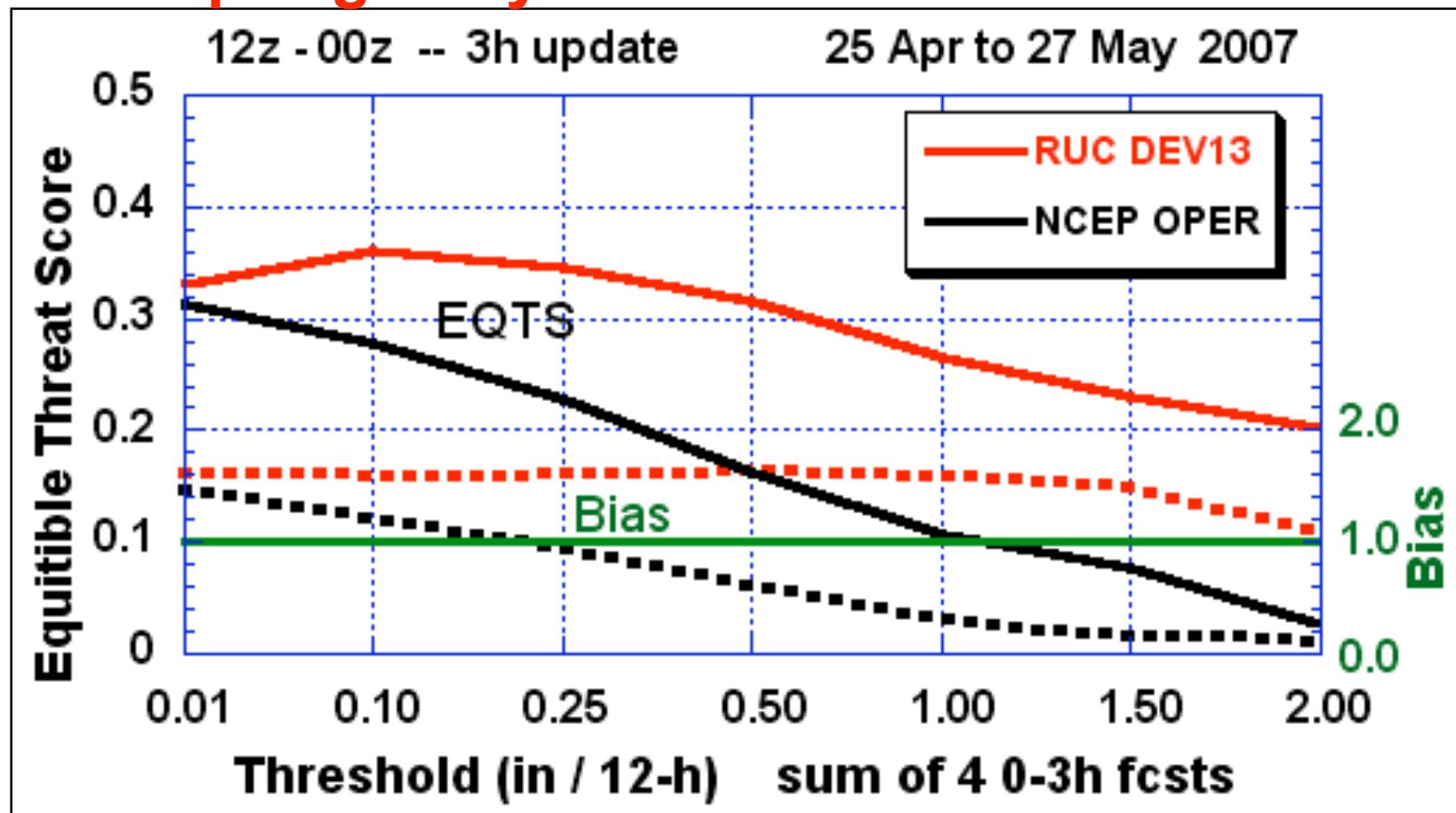
**Sfc Temp – 21z  
Tues 17 July 2007**

>60.0    >70.0    >80.0    >90.0    >100.0



# Radar assimilation impact on 3-h precipitation skill scores

- Significant improvement in ETS and bias
- Spring - daytime

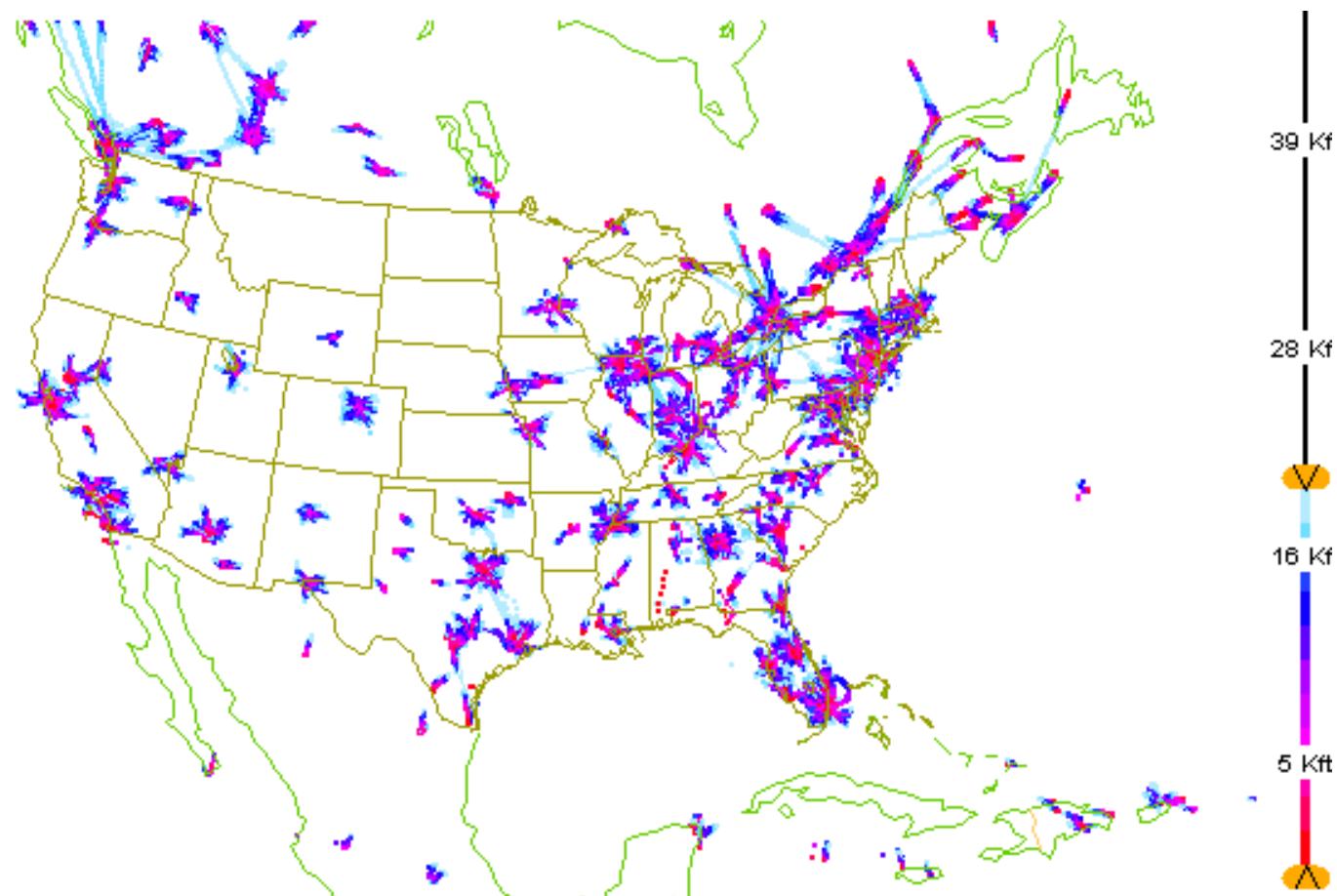


## **(On RUC assimilation of TAMDAR data)**

### **- AMDAR and TAMDAR definitions**

- “**AMDAR**” (Automated Meteorological Data and Recording) – are automatically sent from commercial aircraft, mostly large jets
- “**TAMDAR**” (Tropospheric AMDAR) – automatic reports from (currently) ~50 turboprops flying regionally in the US Midwest
  - Provided by AirDat LLC
  - Agreement between Northwest Airlines (Mesaba – regional subsidiary) and AirDat LLC
  - New agreement between NWS/FAA and AirDat for use of TAMDAR

Aircraft coverage is limited to major hubs below 20 Kft,  
(without TAMDAR)

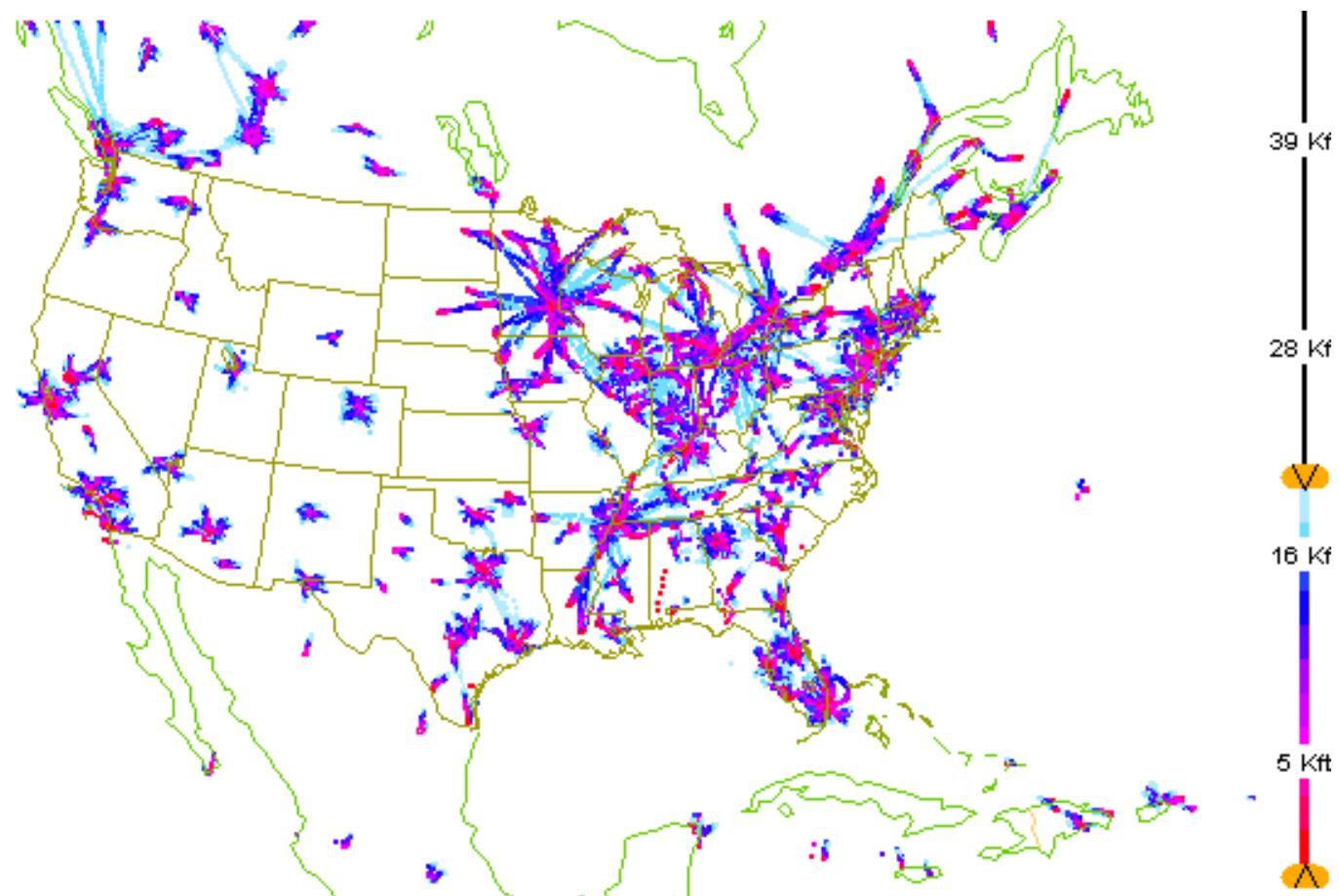


05-Jun-2007 00:00:00 -- 05-Jun-2007 23:59:59 (287984 obs loaded, 102442 in range, 9337 shown)

**NOAA / ESRL / GSD** Altitude: -1000 ft. to 20000 ft.

Good w and T not-TAMDAR

Below 20 Kft, with TAMDAR – better regional coverage  
in the Midwest

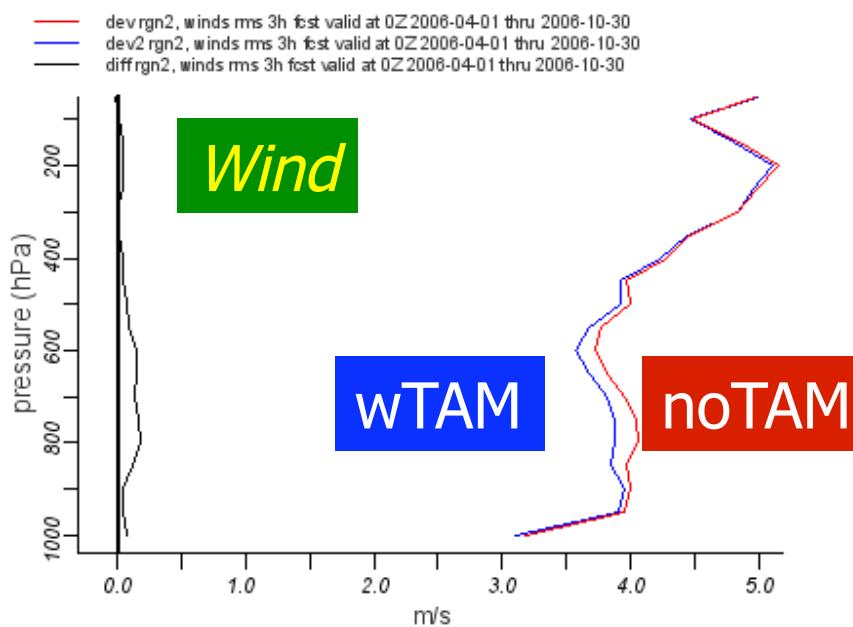
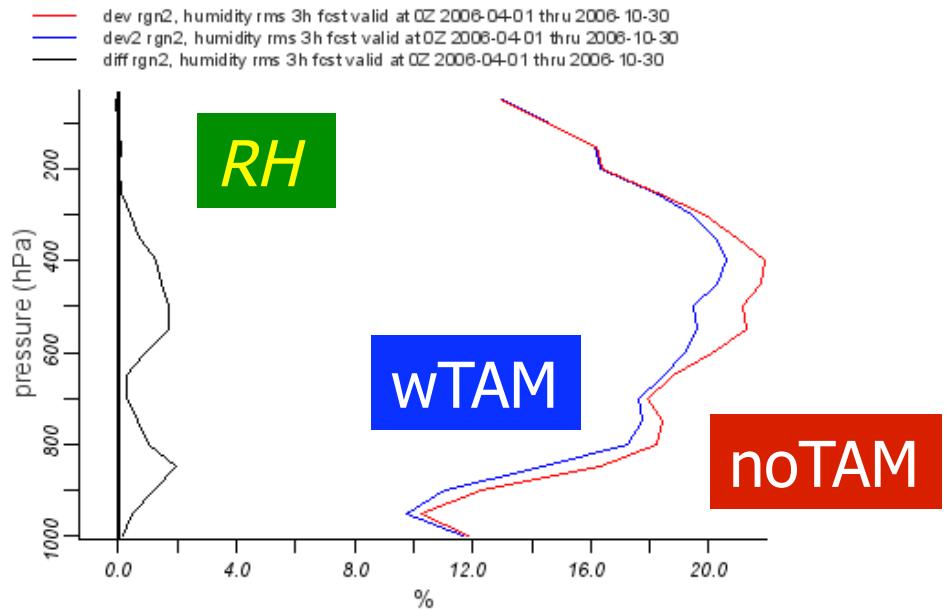
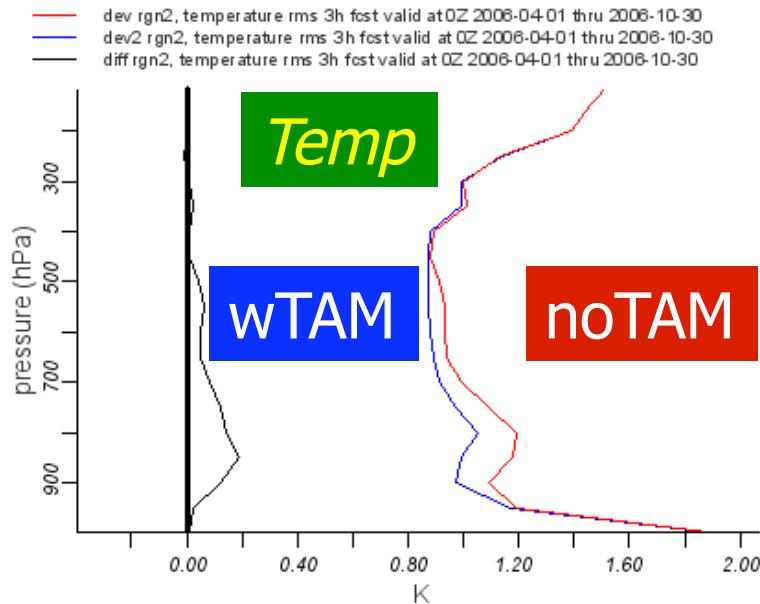


05-Jun-2007 00:00:00 -- 05-Jun-2007 23:59:59 (287984 obs loaded, 112138 in range, 11213 shown)

**NOAA / ESRL / GSD** Altitude: -1000 ft. to 20000 ft.

Good w and T

# 3h Fcst errors – RUCdev (no TAMDAR), RUCdev2 (w/ TAMDAR)



TAMDAR – regional aircraft  
with V/T/RH obs  
GSD impact study with RUC parallel cycles

- 2005-2007 (ongoing)
- 10-30% reduction in  
RH, temperature, wind fcst  
error w/ TAMDAR

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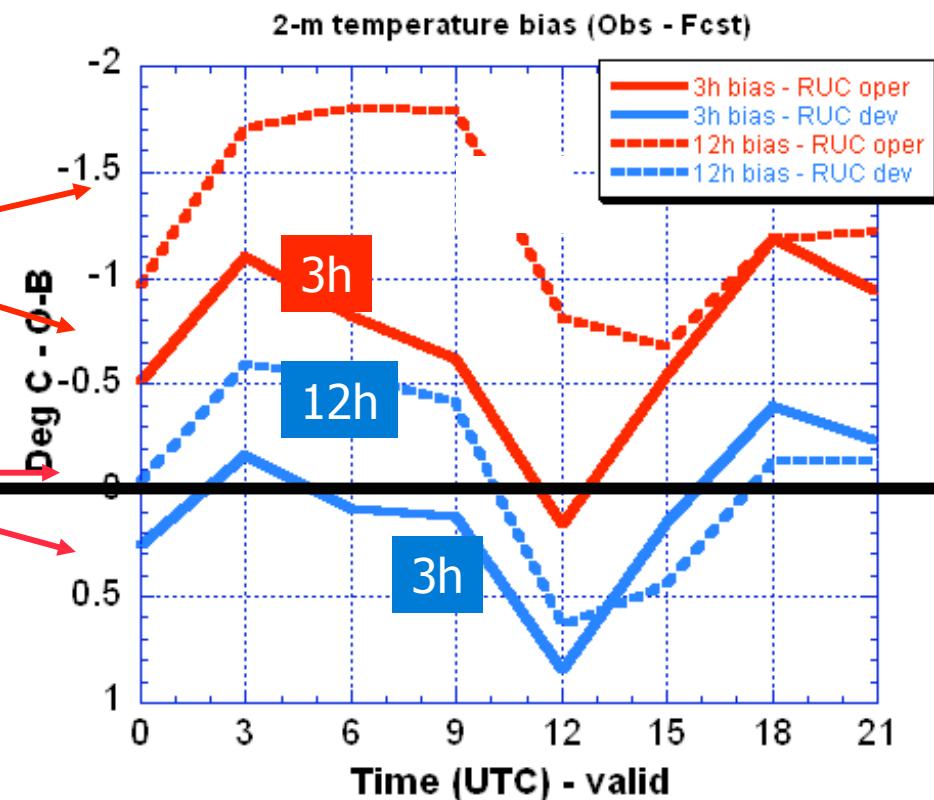
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# RRTM Longwave Radiation in RUC Upgrade Effect on 2-m temperature forecasts

- Much decreased warm bias near surface

1-month comparison  
14 May – 13 June 07  
Eastern US only

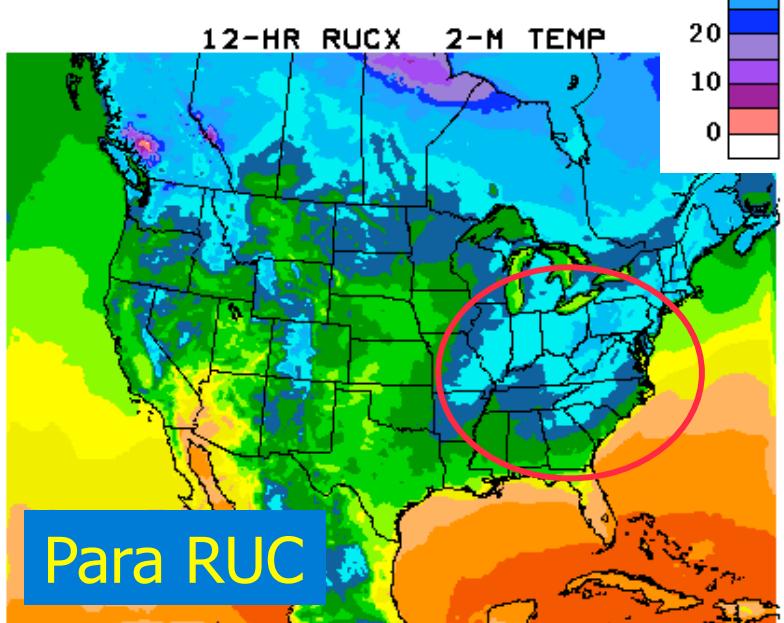
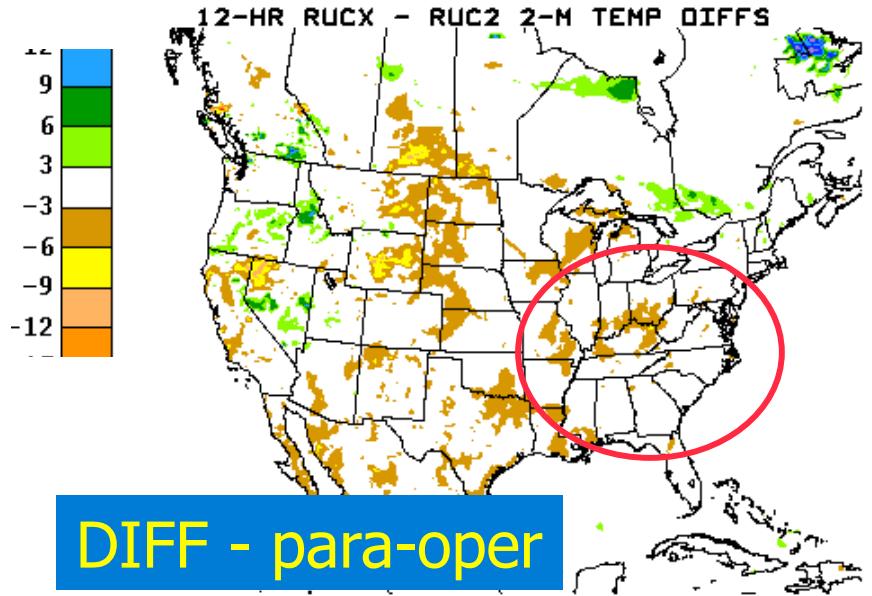
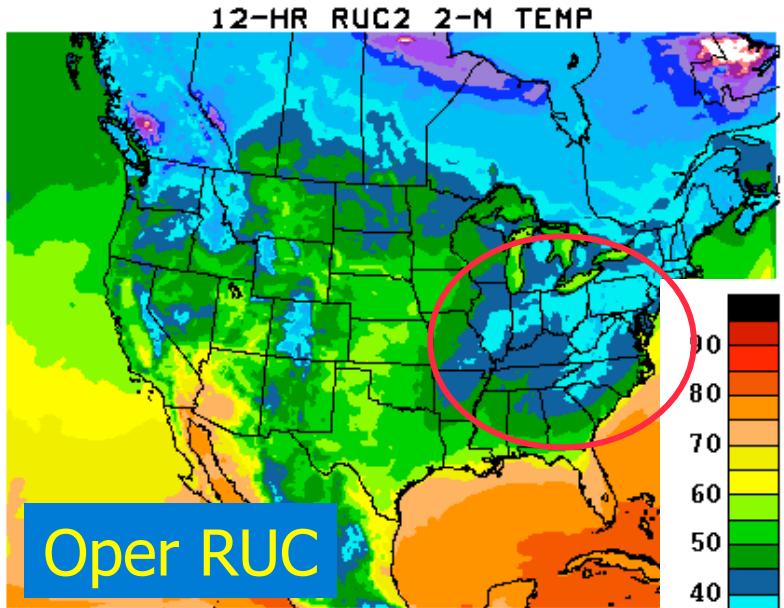
2-m temp bias (obs – forecast)



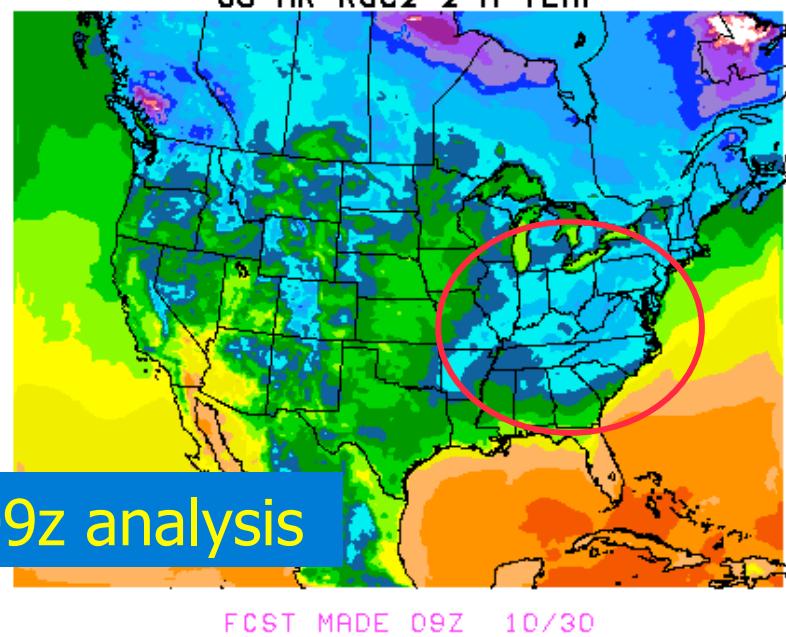
RUC oper – Dudhia LW

RUC para – RRTM LW

WARM  
COLD



Better 2m temp forecast  
From para RUC w/ RRTM LW



12h fcst – valid 09z 30 Oct

# Grell-Devenyi Convection

## Changes to address recent issues

**Reduce weight given to Arakawa-Schubert closure**  
**Result: Reduces the high spatial coverage bias of small amounts**

**Use smaller depth for cap adequate to deny convective initiation**

**Result: convection starts later in diurnal cycle**

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## Ongoing tests

- EMC testing – warm season

## Preliminary evaluation of technical aspects of implementation (assumed to be computational/NCO/resource issues)

- None yet
- No increase in run time anticipated
- Radar reflectivity processing RFC (Request For Change) submitted to NCO but not yet implemented

## Downstream impacts, product changes

- 6 additional 2-d fields in isobaric output files
- 4 additional 2-d fields in native output files
- correction to GRIB identifiers for a few fields